

# Pediatric CO Poisoning

## Section 1: Case Summary

Scenario Title: Pediatric CO Poisoning	
Keywords:	
Brief Description of Case:	A 5-year-old boy is brought to the ED by paramedics after being rescued from a apartment fire. The boy was found unconscious in his bed. His room was filled with thick smoke. He will need to be treated as a trauma patient, including intubation for airway protection, treated for potential cyanide poisoning and severe CO toxicity with transfer to HBO chamber.

Goals and Objectives	
Educational Goal:	
Objectives: (Medical and CRM)	<ul style="list-style-type: none"><li>• To understand the unique aspects of CO poisoning in children</li><li>• To consider co-morbidities associated with CO poisoning including rhabdomyolysis, multi-system trauma, and cyanide poisoning</li><li>• To discuss priorities in management of CO poisoning including oxygen therapy and reducing oxygen consumption</li><li>• To understand indications of HBO treatment in children</li></ul>
EPAs Assessed:	

Learners, Setting and Personnel			
Target Learners:	<input type="checkbox"/> Junior Learners	<input checked="" type="checkbox"/> Senior Learners	<input type="checkbox"/> Staff
	<input type="checkbox"/> Physicians	<input type="checkbox"/> Nurses	<input type="checkbox"/> RTs
	<input type="checkbox"/> Other Learners:		
Location:	<input checked="" type="checkbox"/> Sim Lab	<input type="checkbox"/> In Situ	<input type="checkbox"/> Other:
Recommended Number of Facilitators:	Instructors: 1		
	Confederates:		
	Sim Techs:		

Scenario Development	
Date of Development:	April 2, 20202
Scenario Developer(s):	Navid Deghani, Kaleena Patel
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Last Revision Date:	
Revised By:	
Version Number:	1.0



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## Section 2A: Initial Patient Information

A. Patient Chart					
Patient Name: Smokey Robinson		Age:5	Gender: M	Weight: 18kg	
Presenting complaint: caught in a house fire					
Temp: 37.2	HR: 155	BP: 68/36	RR: 25	O <sub>2</sub> Sat: 98%	FiO <sub>2</sub> :
Cap glucose: 7.6		GCS: (E V M ) 3			
Triage note: Direct to care					
Allergies: none					
Past Medical History:  none			Current Medications:  none		

## Section 2B: Extra Patient Information

A. Further History	
<i>Include any relevant history not included in triage note above. What information will only be given to learners if they ask? Who will provide this information (mannequin’s voice, confederate, SP, etc.)?</i>	
Information from paramedics: House fire, possibly from candles. Family was sleeping, neighbours called 911. Mother also brought to ED unconscious, mother’s boyfriend was outside the home when we arrived, he did not come to hospital.	
B. Physical Exam	
<i>List any pertinent positive and negative findings</i>	
Cardio: sinus tachycardia, no murmurs	Neuro: no response to pain, GCS 3, PERLA
Resp: shallow resps, no stridor	Head & Neck: no palpable hematomas
Abdo: soft, not distended	MSK/skin: soot covering clothes, face, neck, hair, second degree burns on right cheek and arm.
Other: lips and tongue not swollen	



## Section 3: Technical Requirements/Room Vision

<b>A. Patient</b>
<input checked="" type="checkbox"/> Mannequin <i>(specify type and whether infant/child/adult)</i> CHILD
<input type="checkbox"/> Standardized Patient
<input type="checkbox"/> Task Trainer
<input type="checkbox"/> Hybrid
<b>B. Special Equipment Required</b>
Mannequin to be marked with black chalk/charcoal, burns placed on right cheek and arm.
<b>C. Required Medications</b>
Ketamine, rocuronium, hydroxycobolamin
<b>D. Moulage</b>
<b>E. Monitors at Case Onset</b>
<input checked="" type="checkbox"/> Patient on monitor with vitals displayed
<input type="checkbox"/> Patient not yet on monitor
<b>F. Patient Reactions and Exam</b>
<i>Include any relevant physical exam findings that require mannequin programming or cues from patient (e.g. – abnormal breath sounds, moaning when RUQ palpated, etc.) May be helpful to frame in ABCDE format.</i>

## Section 4: Confederates and Standardized Patients

Confederate and Standardized Patient Roles and Scripts	
Role	Description of role, expected behavior, and key moments to intervene/prompt learners. Include any script required (including conveying patient information if patient is unable)



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## Section 5: Scenario Progression

Scenario States, Modifiers and Triggers				
Patient State/Vitals	Patient Status	Learner Actions, Modifiers & Triggers to Move to Next State		Facilitator Notes
<b>1. Baseline State</b> HR: 142 BP: 68/36 RR: 24 Sats: 97% Gluc: 3.4 Temp: 37.2	GCS: opens eyes to painful stimuli and doesn't localize pain	<u>Expected Learner Actions</u>  <input type="checkbox"/> Apply O2 via NRB with reservoir bag to deliver ~100% FiO2 <input type="checkbox"/> Obtain IV, place C-collar, check cap glucose <input type="checkbox"/> recognize hypotension and give fluid bolus <input type="checkbox"/> Decision to intubate >> complete peds intubation checklist <input type="checkbox"/> order ECG, labs, CXR <input type="checkbox"/> Hydroxocobalamin 70 mg/kg/dose, max dose 5 grams	<u>Modifiers</u> -if no decision to intubate within 5 minutes, bradypnea with stridor -hypotension improves with fluid bolus  <u>Triggers</u> -intubation >> stage 2	
<b>2.</b> HR: 145 BP: 86/43 RR: rate of ventilation Sats: 100% on 100% oxygen	GCS: no response	<u>Expected Learner Actions</u>  <input type="checkbox"/> head-to-toe exam incl log-roll <input type="checkbox"/> Receive and interpret labs <input type="checkbox"/> Recognize acidosis and give hydroxycobalamin if not already given in step 1 <input type="checkbox"/> insert foley <input type="checkbox"/> Discuss neuroimaging	<u>Modifiers</u> -if no foley inserted already, RN to ask how much maintenance fluid to give incl any boluses  <u>Triggers</u> - if no hydroxycobalamin given, acidosis and clinical status worsens >> stage 3 -10 minutes passes or all steps completed >> stage 4	



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		<input type="checkbox"/> complete peds burn diagram and calculate BSA involved (5-8%2nd degree) <input type="checkbox"/> Consult BCCH PICU for HBO		
<b>3. Clinical deterioration</b> HR: 49 BP: 62/15 Sats: 82% on 100% oxygen		<u>Expected Learner Actions</u>  <input type="checkbox"/> give antidote <input type="checkbox"/> go through DOPE mnemonic, fluid, pressors	<u>Modifiers</u> -if no antidote given within 5 minutes >> cardiac arrest and end of scenario  <u>Triggers</u> -if antidote given within 5 minutes >> stage 4	
<b>4. Stablization and transfer</b>		<u>Expected Learner Actions</u> <input type="checkbox"/> Consult BCCH PICU for HBO	<u>Modifiers</u>  <u>Triggers</u>	



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## Appendix A: Laboratory Results

Gas:		CK 656 U/L
	– pH	7.06
	– PCO2	58 mmHg
	– HCO3	13 mmol/L
	– BE	-13.0 mmol/L
	– COHb	19%
CBC:		hsTrop 30
	– Hgb	110 g/L
	– HCT	0.34 L/L
	– WBC	18.0 x 10 <sup>9</sup> /L
	– PMN:	13.2 x 10 <sup>9</sup> /L
	– PLT	565 x 10 <sup>9</sup> /L
Lytes:		
	– Na+	133 mmol/L
	K+	4.1 mmol/L
	– HCO3-	14 mmol/L
	Chloride	96 mmol/L
	– Anion Gap	21 mmol/L
	– BUN	6.0 mmol/L
	– CREAT	52 umol/L
	Lactate	12.8 mmol/L
Glucose		3.1 mmol/L
	– CRP	12.3



Appendix B: ECGs, X-rays, Ultrasounds and Pictures

Paste in any auxiliary files required for running the session. Don't forget to include their source so you can find them later!

EMERGENCY INTUBATION CHECKLIST

Is a difficult airway anticipated? If YES, CALL ANESTHESIA.

PATIENT PREPARED?

☐ Functioning IV/IO

☐ Expose patient

☐ Optimize patient position

☐ Pre-oxygenate patient

☐ Failed intubation backup plan?

EQUIPMENT READY?

☐ Suction

☐ rigid suction catheter turned on max

☐ Oxygen

☐ mask

☐ bag-valve

☐ anesthesia circuit

☐ Airway equipment

☐ working laryngoscope and blade

☐ ETT plus extra 0.5 smaller size

☐ lubricated stylet

☐ oral airways

☐ LMA

☐ Pharmacologic agents

☐ induction/paralytic drugs

☐ fluids / vasopressor?

☐ Monitoring Equipment

☐ SaO<sub>2</sub>

☐ ECG

☐ BP

☐ ET/CO<sub>2</sub>

TEAM READY?

☐ Gown, glove and eye protection

☐ Team leader identified

☐ RT

☐ Nurse to administer medications

PLAN FOR CONSEQUENCES

☐ Successful intubation?

☐ secure ETT

☐ ongoing sedation / paralysis

☐ ventilation parameters set

☐ Failed intubation backup plan?

☐ Document procedure in chart

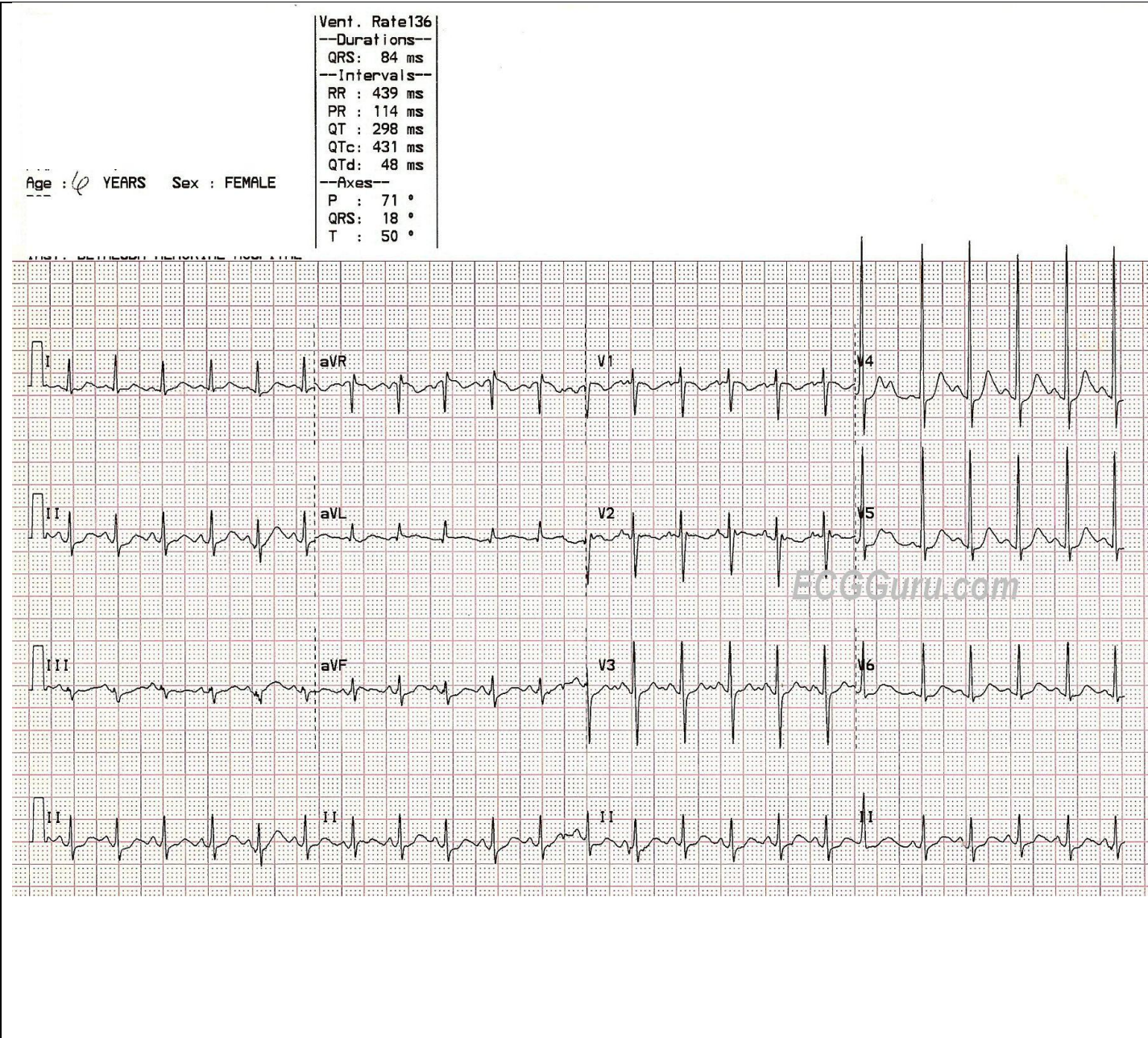
To be completed with EVERY intubation.

Peter W. Skippen / Vers. 2  
2014-04-20

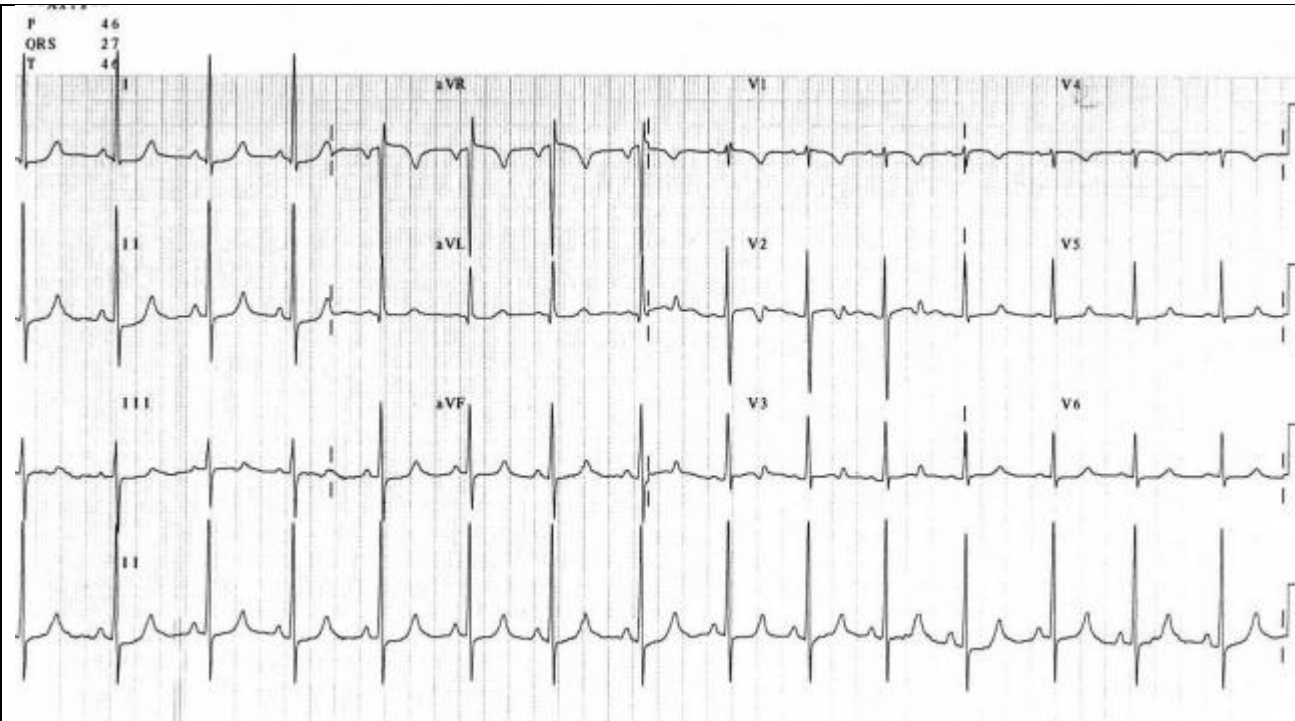
Return completed form to the ED Medical Director.



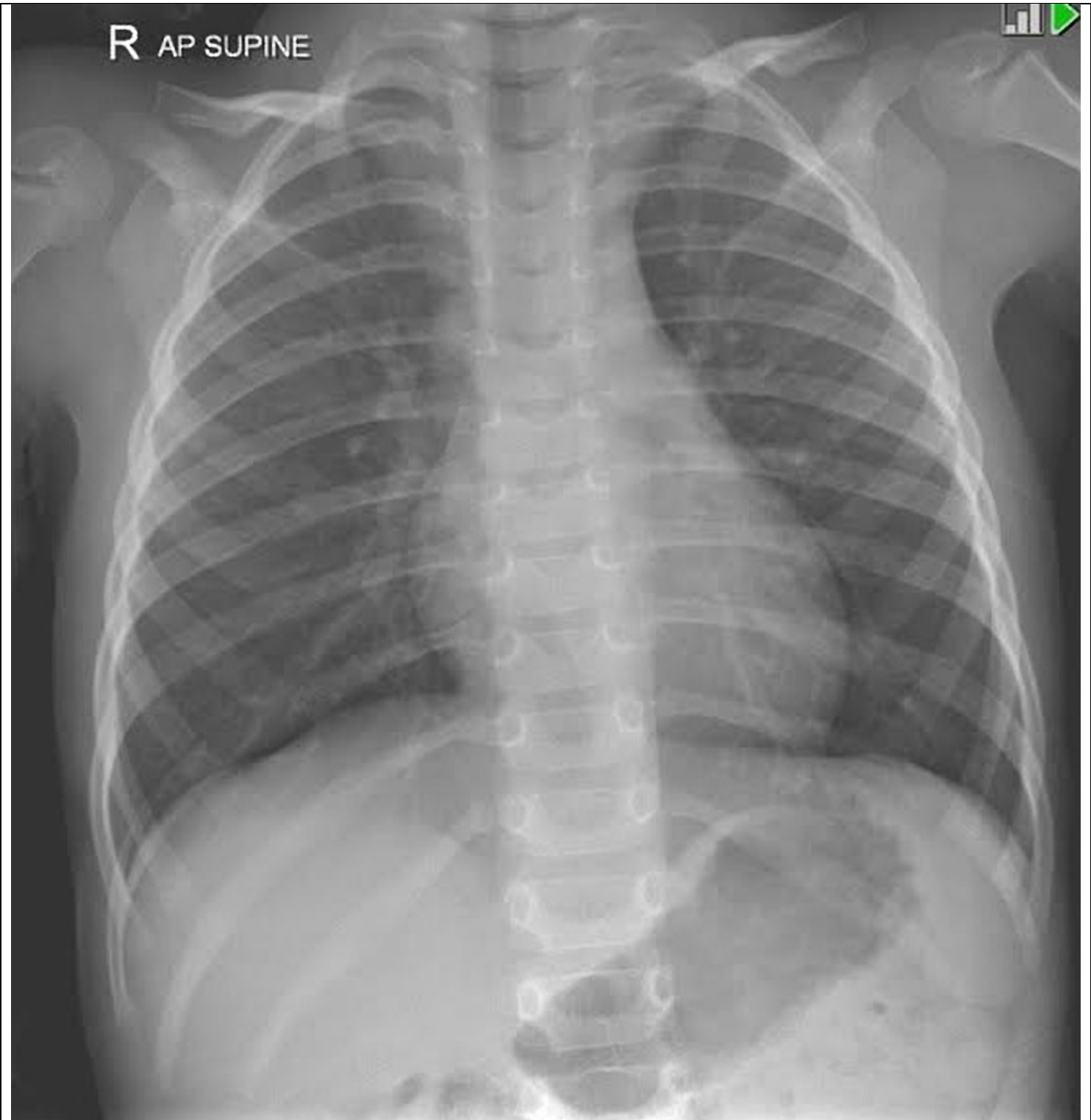
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<http://www.cmej.org.za/index.php/cmej/article/view/2283/2048>



<https://radiopaedia.org/cases/normal-chest-radiograph-paediatric?lang=us>



## Appendix C: Facilitator Cheat Sheet & Debriefing Tips

*Include key errors to watch for and common challenges with the case. List issues expected to be part of the debriefing discussion. Supplemental information regarding any relevant pathophysiology, guidelines, or management information that may be reviewed during debriefing should be provided for facilitators to have as a reference.*

- Children are more vulnerable to CO poisoning given increased metabolic demand, increased minute ventilation, and higher affinity of fetal Hgb to the CO molecule.
- Vital signs and ABG are often normal in CO poisoning. PaO<sub>2</sub> is normal. SpO<sub>2</sub> is spuriously normal. Routine pulse oximetry does not accurately reflect patient's hypoxemia.
- COHb is used diagnostically and to prognosticate, but it only measures CO bound to Hgb, not CO bound to cellular molecules.
  - Metabolic acidosis (pH<7.20) should prompt considerations of cyanide co-poisoning.
  - Victims of CO poisoning should be treated like trauma patients. The unconscious patients should be placed in a c-collar.
  - Mainstay of treatment is oxygen therapy. Use a non-rebreather mask with reservoir to provide 100% oxygen. If intubation is required, patients are ventilated with 100% oxygen.
- In addition, the child's oxygen consumption and metabolic demands should be reduced. Measures include euolemia, normothermia, normalization of vital signs, normocarbida, normoglycemia, anxiolysis +/- paralysis.
- Rhabdomyolysis (caused by depletion of ATP leading to disintegration of the myocytes) should be treated with hydration and diuretics to achieve adequate urine output.
- Role of HBO therapy in CO poisoning in children remains controversial. Any derived benefit remains unproven. Given theoretical benefit, HBO use is a therapeutic option and is often used in those with severe exposures (COHb > 20-25%) or those with persistent symptoms: (CO>20 percent in pregnant patient); Loss of consciousness, Severe metabolic acidosis (pH <7.1), Evidence of end-organ ischemia (eg, ECG changes, chest pain, or altered mental status)
  - -Practical considerations include middle ear and sinus barotrauma. Infants routinely require tympanostomies prior to their 'dive' in the HBO chamber.
- Cyanide poisoning should be treated with hydroxocobalamin. Cyanide can be liberated during the combustion of products containing both carbon and nitrogen. These products include wool, silk, polyurethane (insulation/upholstery), polyacrylonitriles (plastics), melamine resins (household goods), and synthetic rubber.
- A minor pathway for cyanide detoxification involves [hydroxocobalamin](#), the precursor to [vitamin B12](#). Circulating hydroxocobalamin combines with cyanide to form cyanocobalamin, which is safely excreted in the urine.

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## References

1. Macnow TE & Waltzman ML. Carbon Monoxide Poisoning in Children: Diagnosis and Management in the Emergency Department. EB Pediatric Emergency Medicine Practice. 13(9) 2016 (Sept).
2. <https://pedemmorsels.com/carbon-monoxide-poisoning-in-children/>
3. BCCH BURN RESUSCITATION PROTOCOL – INITIAL 48 HOURS: [http://www.phsa.ca/our-services-site/Documents/Pediatric\\_Burn\\_Resuscitation\\_Initial48hrs.pdf](http://www.phsa.ca/our-services-site/Documents/Pediatric_Burn_Resuscitation_Initial48hrs.pdf)

